State of Illinois
John Stelle, Governor

Department of Registration and Education
John J. Hallihan, Director

PRELIMINARY REPORT ON AVAILABILITY AND USE OF WATERFOWL FOOD PLANTS IN THE ILLINOIS RIVER VALLEY

Frank C. Bellrose, Jr.
Harry G. Anderson

Published by Authority of the State of Illinois

NATURAL HISTORY SURVEY
Theodore H. Frison, Chief

Biological Notes No. 15 Urbana, Illinois December, 1940

PRELIMINARY REPORT ON AVAILABILITY AND USE OF WATERFOWL FOOD PLANTS IN THE ILLINOIS RIVER VALLEY

Frank C. Bellrose, Jr., and Harry G. Anderson*

Because studies conducted in the past on duck food habits have covered extensive rather than localized areas, the abundance of aquatic plants and their use by waterfowl have never before been correlated to secure an index rating of value for these plants.

The Illinois River was selected for the investigation outlined below because it offered exceptional opportunities for intensive studies of duck foods. Vegetation of lakes was easy to map, base maps scaled 5¼ inches to the mile were available and duck gizzards were obtainable in quantity from hunting clubs.

In 1938, the senior author inaugurated the study by mapping the vegetation communities of over 20 lakes and by collecting waterfowl gizzards from hunting clubs. On June 1, 1939, the junior author was employed to undertake Pittman-Robertson Project No. 2-R, set up under terms of the Federal Aid in Wildlife Restoration Act, to determine the contents of waterfowl gizzards collected in 1938 and to collect and examine gizzards in 1939 and 1940.

Since the value of a plant is believed to change with its abundance, the decision was made to conduct the study for two or more years. This paper is a preliminary report on data obtained in 1938. Because of changes in water levels favorable to certain species, later studies may add other species to the list of desirable plants included in this paper.

INDEX RATING OF WATERFOWL FOODS

The index rating of the utilization of waterfowl food plants was obtained by dividing the per cent of use by the per cent of abundance. Per cent of use data were based upon volumetric measurement by the junior author of the contents of 1,147 waterfowl gizzards collected in four areas. Per cent of abundance data were based upon area in acres of various vegetation communities, the area in each case being obtained by a planimeter used on vegetation maps made by the senior author.

Because of the impossibility of obtaining accurate figures, no measurement was made of the abundance of certain plants, and these plants were disregarded in calculating the per cent of abundance of other plants.

---

*Frank C. Bellrose, Jr., Assistant Game Technician, Illinois Natural History Survey; Harry G. Anderson, Junior Biologist, Illinois Natural History Survey, State Department of Conservation and U. S. Fish and Wildlife Service (Federal Aid Program).

An index rating of 1.0 indicates that the food plants so rated were used approximately in proportion to their abundance. An index rating greater than 1.0 indicates that the food was preferred and sought by ducks; of less than 1.0, that the food was less popular than it was abundant.

POSSIBLE SOURCES OF ERROR

The index rating figure may or may not be a precise indicator of the relative value of a waterfowl food plant. Habits of waterfowl, plant differences and habitat characteristics are factors tending to prevent a minutely exact rating figure.

Ducks frequently feed in more than one lake in the same day. The area in which a duck is killed may not be that in which it has filled its gizzard, and yet the mechanics of this study have made necessary the tacit assumption that the contents of each gizzard were gathered in the area in which the duck was killed.

Accurate measurement of the differences in food yields of the same species of plant under varying conditions has not been possible in this study. For example, sago pondweed is very erratic in seed production. Some beds produce no seed; others produce a large amount. In the case of several species, seeds were available to ducks in an area in which no plants were seen; the seeds had been dropped in the mud by the previous year's plants but had not sprouted to produce vegetation. Then, too, no accurate measurement has been possible of the effect of differences in water level on the availability to ducks of plant parts. Low water, or no water, may preclude the use of certain food plants; water of greater than usual depth may have the same effect with respect to other plants.

The index rating in each case should be considered relative rather than exact for the reason that no numerical values were recorded for abundance of certain plants, and these plants were disregarded in calculating the per cent of abundance of other plants, whereas all plants were included in calculating the per cent of use.

Even though the possibility of error in individual ducks, or in individual areas, is great, the authors believe that in those food plants in which the number of samples is large the errors tend to cancel each other. Field observations confirm or only slightly modify the findings presented in table 1. The index rating column seems sufficiently valid to justify its use in planting programs, at least for the eight plants with the highest percentage of use. Of the first eight, those with a low index rating should be avoided in most planting programs.

AREAS UNDER INVESTIGATION

Most of the duck gizzards collected in 1938 were from but 4 areas of the 20 that were mapped. Therefore, the per cent of abundance of aquatic plants on only these four areas has been considered in this study. These sample areas contained representatives of all important plants existing in the Illinois River Valley, under three different types of water levels.

The four areas are as follows:

1. Cuba Island, near the mouth of the Sangamon River. This area had semistabilized water levels; rice cut-grass and marsh smartweed formed the two major food plants. Duck gizzards examined from this area totaled 289.

2. Crane Lake and a marsh adjacent to it, in the vicinity of Snicarte. The lake had fluctuating water levels in 1938; the marsh semistable water levels. Duck gizzards examined from this area totaled 293.

3. Lake Chautauqua and Clear Lake, which lie adjacent to each other, north of Havana. The former had a stable water level, with an abundance of coontail, longleaf and sago pondweeds and marsh smartweed. The latter had fluctuating water levels and a paucity of duck food plants. While all the duck gizzards were collected at Clear Lake, field observations indicated that the ducks obtained most of the natural food from Lake Chautauqua. Gizzards examined from this area totaled 358.

4. Duck Island, a short distance from Lake Chautauqua and Clear Lake, had semistabilized water levels. Coontail, marsh smartweed and duck potato were the most important native duck food plants. Duck gizzards examined from this area totaled 207.

WATERFOWL FOODS ON FOUR AREAS

In table 1 are listed the 20 aquatic plants that occurred in greatest abundance in the four areas considered as a whole. Of these, only eight were used extensively for food by waterfowl. This table presents a comparison between abundance and use of waterfowl food plants, with an index rating of their value for the study areas considered as a whole.

In order to illustrate the effect of environmental conditions, which alter the value of duck food plants in different types of habitat, the abundance, use and index ratings of duck food plants summarized in table 1 are presented for each of the four sample areas in tables 2, 3, 4 and 5.

Table 1. - Per cent of use, per cent of abundance and index rating of aquatic plants in four areas of the Illinois River Valley, 1938.

Plant	Per Cent of Use	Per Cent of Abundance	Index Rating
Rice cut-grass (Leersia oryzoides)	20.46	0.73	39.00
Coontail (Ceratophyllum demersum)	22.72	14.20	1.68
Nutgrasses (Cyperus spp.)	11.73	trace	high
Marsh smartweed (Polygonum Muhlenbergii)	9.61	14.43	0.66
Longleaf pondweed (Potamogeton americanus)	5.35	13.48	0.43
Buttonbush (Cephalanthus occidentalis)	3.49	abundant	low
Teal grass (Eragrostis hypnoides)	3.16	trace	medium
Water hemp (Acnida tuberculata)	2.17	trace	medium
Smartweeds (Polygonum spp.) **	1.63	trace	medium
Duck potato (Sagittaria latifolia)	1.40	7.14	0.20
Sago pondweed (Potamogeton pectinatus)	0.39	3.81	0.10
American lotus (Nelumbo lutea)	0.30	28.30	0.01
Giant burreed (Sparganium eurycarpum)	0.35	trace	low
River bulrush (Scirpus fluviatilis)	0.30	9.97	0.03
White waterlily (Castalia tuberosa)	0.21	0.80	0.26
Marsh cord grass (Spartina Michauxiana)	0.15	0.70	0.21
Spike rushes (Eleocharis spp.)	0.05	1.04	0.05
Pickerelweed (Pontederia cordata)	0.00	0.40	very low
Bushy pondweed (Najas guadalupensis)	0.00	trace	very low
Mud plantain (Heteranthera dubia)	0.00	trace	very low
Other native foods (total of 50)	7.45	***	

**Other than Muhlenbergii.

***No figure given because of difficulty of measurement

Table 2. - Per cent of use, per cent of abundance and index rating of aquatic plants at Cuba Island, 1938.

Plant	Per Cent of Use	Per Cent of Abundance	Index Rating
Rice cut-grass (Leersia oryzoides)	53.76	3.04	17.68
Nutgrasses (Cyperus spp.)	16.65	trace	high
Marsh smartweed (Polygonum Muhlenbergii)	8.92	48.70	1.83
Teal grass (Eragrostis hypnoides)	6.53	trace	high
Coontail (Ceratophyllum demersum)	3.39	0.15	22.60
Water hemp (Acnida tuberculata)	3.11	0.00*	high
Buttonbush (Cephalanthus occidentalis)	2.83	abundant	low
Smartweeds (Polygonum spp.)**	1.92	trace	high
Longleaf pondweed (Potamogeton americanus)	0.67	0.60	1.12
Sago pondweed (Potamogeton pectinatus)	0.10	trace	low
Duck potato (Sagittaria latifolia)	0.10	trace	low
River bulrush (Scirpus fluviatilis)	0.09	trace	low
Spike rushes (Eleocharis spp.)	0.05	trace	low
American lotus (Nelumbo lutea)	0.00	42.31	very low
Marsh cord grass (Spartina Michauxiana)	0.00	5.20	very low
Other native foods (total of 28)	1.88	***	

*None recorded for the area.

**Other than Muhlenbergii.

***No figure given because of difficulty of measurement.

Table 3 - Per cent of use, per cent of abundance and index rating of aquatic plants at Crane Lake and adjacent marsh, 1938.

Plant	Per Cent of Use	Per Cent of Abundance	Index Rating
Coontail (Ceratophyllum demersum)	18.79	1.40	13.42
Rice cut-grass (Leersia cryzoides)	17.42	3.50	4.98
Nutgrasses (Cyperus spp.)	12.35	0.00*	high
Marsh smartweed (Polygonum Muhlenbergii)	8.66	2.80	3.09
Buttonbush (Cephalanthus occidentalis)	8.55	abundant	medium
Water hemp (Achida tuberculata)	4.03	0.00*	medium
Smartweeds (Polygonum spp.)**	2.35	0.00*	medium
Sago pondweed (Potamogeton pectinatus)	2.02	1.60	1.26
American lotus (Nelumbo lutea)	1.51	72.90	0.02
White waterlily (Castalia tuberosa)	1.17	6.10	0.19
Longleaf pondweed (Potamogeton americanus)	0.98	0.10	9.80
Teal grass (Eragrostis hypnoides)	0.88	0.00*	medium
River bulrush (Scirpus fluviatilis)	0.37	9.10	0.04
Giant burreed (Sparganium eurycarpum)	0.27	0.00*	low
Spike rushes (Eleocharis spp.)	0.14	0.00*	low
Marsh cord grass (Spartina Michauxiana)	0.02	1.00	0.02
Duck potato (Sagittaria latifolia)	0.01	1.50	0.006
Other native foods (total of 34)	20.48	***	

*None recorded for the area.

**Other than Muhlenbergii.

***No figure given because of difficulty of measurement.

Table 4. - Per cent of use, per cent of abundance and index rating of aquatic plants at Lake Chautauqua and Clear Lake, 1938.

Plant	Per Cent of Use	Per Cent of Abundance	Index Rating
Coontail (Ceratophyllum demersum)	23.74	27.91	0.85
Longleaf pondweed (Potamogeton americanus)	16.14	32.01	0.50
Marsh smartweed (Polygonum Muhlenbergii)	14.21	9.40	1.51
Nutgrasses (Cyperus spp.)	12.80	trace	medium
Duck potato (Sagittaria latifolia)	6.39	2.01	3.18
Buttonbush (Cephalanthus occidentalis)	3.80	abundant	low
Sago pondweed (Potamogeton pectinatus)	3.03	20.55	0.15
Rice cut-grass (Leersia oryzoides)	2.34	0.00*	high
Smartweeds (Polygonum spp.)**	1.58	trace	high
River bulrush (Scirpus fluviatilis)	1.27	5.62	0.23
Giant burreed (Sparganium eurycarpum)	0.95	trace	medium
Water hemp (Acnida tuberculata)	0.07	0.00*	low
Spike rush (Eleocharis spp.)	0.04	2.50	0.02
Bushy pondweed (Najas guadalupensis)	0.01	trace	low
Other native foods (total of 34)	13.63	***	

*None recorded for the area.

**Other than Muhlenbergii.

***No figure given because of difficulty of measurement.

Table 5. - Per cent of use, per cent of abundance and index rating of aquatic plants at Duck Island, 1938.

Plant	Per Cent of Use	Per Cent of Abundance	Index Rating
Coontail (Ceratophyllum demersum)	66.56	6.50	10.24
Longleaf pondweed (Potamogeton americanus)	14.14	trace	high
Marsh smartweed (Polygonum Muhlenbergii)	8.77	15.60	0.56
Duck potato (Sagittaria latifolia)	2.04	17.00	0.12
Rice cut-grass (Leersia oryzoides)	1.28	0.00*	high
Giant burreed (Sparganium eurycarpum)	0.79	trace	medium
Marsh cord grass (Spartina Michauxiana)	0.71	0.00*	low
American lotus (Nelumbo lutea)	0.51	42.60	0.01
Smartweeds (Polygonum spp.)**	0.43	0.00*	medium
Buttonbush (Cephalanthus occidentalis)	0.41	common	low
River bulrush (Scirpus fluviatilis)	0.20	18.10	0.01
Sago pondweed (Potamogeton pectinatus)	0.18	trace	medium
White waterlily (Castalia tuberosa)	0.00	0.20	very low
Other native foods (total of 39)	3.98	***	

*None recorded for the area

**Other than Muhlenbergii

***No figure given because of difficulty of measurement

VALUE OF FOOD PLANTS STUDIED

The value as waterfowl food of the most abundant aquatic plants in the Illinois River Valley in 1938 is discussed below, plant by plant. Statements are based upon data obtained in the four study areas mentioned above.

RICE CUT-GRASS, Leersia oryzoides Sw., in 1938 was apparently the best native duck food plant in the Illinois River region, with an index rating of 39.00 for the four study areas considered as a whole. At Cuba Island, where an excellent bed occurred, it rated second to coontail. Perhaps there coontail was more abundant than recorded. In early summer, many coontail plants were noticed at Cuba Island in a large bed of marsh smartweed, but, when the vegetation was mapped in August, the water was so low that it was virtually impossible to work a boat into the bed and ascertain the extent of the coontail. At Crane Lake, rice cut-grass was second to long-leaf pondweed in index rating. There only a small portion of the rice cut-grass bed was available to the ducks because the birds could not feed on the rootstocks of the many plants that were not flooded.

COONTAIL, Ceratophyllum demersum L., was slightly below rice cut-grass in actual use, but, since it was much more abundant, its index rating for the four study areas considered as a whole was only 1.68. This species grew almost exclusively in areas with stable or semistable water levels. Of the four areas studied, the best for demonstrating the value of coontail was Duck Island, where this species was first in value, with an index rating of 10.24. In the Clear Lake region, coontail had a lower index rating than duck potato or marsh smartweed.

NUTGRASSES, Cyperus erythrorhizos Muhl., Cyperus strigosus L., and Cyperus esculentus L., formed 11.73 per cent of all native duck foods in the gizzards examined; yet in 1938 these species occurred only as small patches in a few places in the four areas from which gizzards were collected. How was it possible for ducks to obtain such a large volume of food from these small-seeded species?

In 1938 a large per cent of the waterfowl on the study areas fed on mud flats as well as in shallow lake water. No plants were seen growing on the mud flats--exposed areas of the shallow lake basins. In the two preceding years, 1936 and 1937, because the water had receded early in the summer, nutgrasses (as well as smartweeds, water hemp and teal grass) formed luxuriant beds on the mud flats. The conjecture was made that large quantities of seed dropped by the 1936 and 1937 crops of these plants furnished food for ducks in 1938.

To substantiate or disprove this conjecture, several mud samples were collected from barren mud flats in September, 1940, three years after moist soil plants had grown on these areas. These samples, collected from 18 square feet of surface, yielded 2,500 seeds of Cyperus erythrorhizos and 2,000 seeds of C. strigosus. The above evidence, we believe, lends strong support to the statement that Cyperus seeds found in duck stomachs in 1938 were from 1936 and 1937 crops.

TEAL GRASS, Eragrostis hypnoides (Lam.) BSP., WATER HEMP or PIGWEED, Acnida tuberculata Moq., and SMARTWEEDS, Polygonum spp. (Polygonum Muhlenbergii), as with the nutgrasses, were very scarce in the Illinois River region in 1938, because of unfavorable water levels. Yet they formed, respectively, 3.16, 2.17 and 1.63 per cent of the native food plants taken from the 1,147 duck stomachs examined. We believe that many seeds of these moist soil plants were deposited in 1936 and 1937, when the plants were abundant, and that waterfowl feeding on the barren mud flats in 1938 picked up the seeds. A small sample of mud collected from barren mud flats in 1940 yielded 550 seeds of water hemp.

MARSH SMARTWEED, Polygonum Muhlenbergii (Meisn.) Wats., rated higher than longleaf pondweed, but below coontail, for the four areas as a whole; its index rating was 0.66, about one-third that of coontail. This smartweed rarely produces seed when growing on dry soil. In 1938, seed was produced by all beds in the areas considered. Marsh smartweed was of more value in the Crane Lake area, where a greater scarcity of natural foods existed, than in the other areas.

LONGLEAF PONDWEED, Potamogeton americanus C. & S., had an index rating for the four areas of 0.43, indicating that it was about two-thirds as valuable as marsh smartweed. This pondweed was scarce in the Cuba Island, Crane Lake and Duck Island areas. At Lake Chautauqua, where it ranked fourth in preference, it was the most abundant species, due to stabilized water levels there. In the Crane Lake region, it rated as the second best duck food plant. The high percentage of longleaf pondweed recorded for the gizzards collected at Duck Island was evidently due to the fact that many of the ducks killed there had previously fed in nearby Lake Chautauqua.

GIANT BURREED, Sparganium eurycarpum Engelm., had an extensive distribution, but its occurrence was limited to small, scattered patches. We believe that it formed about 1.0 per cent of the vegetation. This would indicate that burreed was not preferred to longleaf pondweed but was a better food than white waterlily or duck potato.

BUTTONBUSH, Cephalanthus occidentalis L., was approximately as abundant in the Illinois River region in 1938 as was river bulrush. It was, however, seldom within the mapping area, occurring for the most part inside the shore line. Seeds of the buttonbush amounted to 3.49 per cent of the native plant foods found in the duck gizzards examined. This figure probably entitles it to be ranked in 1938 as a better duck food than white waterlily or duck potato. It should be noted that in the stomachs taken from Duck Island and Cuba Island, where natural foods abounded, little buttonbush seed was found. However, in the gizzards taken from Crane Lake, where there was a dearth of good natural food, buttonbush seed amounted to 8.55 per cent of the native plant foods.

WHITE WATERLILY, Castalia tuberosa (Paine) Greene, had an index rating for the four areas of 0.26, almost half that of longleaf pondweed. However, we are hesitant to believe that this waterlily is as valuable as indicated. Its limited distribution and the high content of a few gizzards may have distorted its value. In the Crane Lake region, where the most extensive area of white waterlily occurred and other natural foods were scarce, the index rating was 0.19.

MARSH CORD GRASS, Spartina Michauxina Hitchc., usually considered only a fair duck food, had an index rating for the four areas of 0.21. We believe this rating to be too high; seeds of this species occurred in only two gizzards, which were completely filled with them. The sampling is too small to give a valid index rating.

DUCK POTATO, Sagittaria latifolia Willd., is regarded by many hunters along the Illinois River as a good duck food plant; yet the index rating of 0.20 for the four areas studied indicates that it was one of the least valuable of the plants in 1938. Most tubers of this plant examined in the field were too large for ducks to consume; consequently, most of the food from this plant found in gizzards consisted of seeds. The high index rating, 3.18, for the Clear Lake region was due in part to a number of gizzards containing tubers.

SAGO PONDWEED, Potamogeton pectinatus L., a highly rated duck food, had an index rating of 0.10 for the four areas. It abounded at Lake Chautauqua, forming one-fifth of the vegetation. In other regions it was scarce. For the Clear Lake and Chautauqua region, this species had an index rating of 0.15. In the 1,147 gizzards examined, no foliage or tubers of this plant were found--only seeds. Seed production of this pondweed in the Illinois River Valley was very low in 1938, a situation that may account for the fact that this plant, usually considered an excellent source of duck food, rated as one of the poorest in this region for the year.

SPIKE RUSHES, Eleocharis spp., seemed to be of slight value as duck food in the areas studied in 1938. They had an index rating of but 0.05 and were very limited in their distribution. At Clear Lake a fairly large bed of Eleocharis palustris (L) R. & S. occurred. Its index rating of 0.02 indicates that it had little value as a duck food.

RIVER BULRUSH, Scirpus fluviatilis (Torr.) Gray, a coarse, dominant marsh plant, covered large areas in the Illinois River Valley in 1938, as in most other years. Despite its abundance, only 0.30 per cent of the natural food found in the duck gizzards collected from the four areas was from this species. The index rating for the four areas was 0.03, indicating that this species is one of the least valuable of the duck food plants. The slight value of this plant is due in part to the small quantity of seed it usually produces. Only occasionally does a river bulrush bed produce seed in quantity. In 1938, at Lake Chautauqua, when the bulrush beds produced an abundance of seed, the index rating of this plant for the area was 0.23, almost half that of longleaf pondweed. Generally this bulrush is a weed species, competing for space with more valuable food plants.

AMERICAN LOTUS, Nelumbo lutea (Willd.) Pers., was in 1938 the most abundant plant in the Illinois River Valley. It represented 28.3 per cent of the aquatic vegetation in the areas considered in this paper. Yet the hard, nutlike seeds were so seldom taken by ducks that they totaled only 0.38 per cent by volume of the native duck foods in the stomachs examined. Its index rating of 0.01 indicates that it is one of the poorest of the waterfowl food plants. Since it, like river bulrush, often crowds out more desirable plants, we must consider it a weed in a waterfowl habitat.